[JP,2000-338113,A]

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FULL CONTENTS CLAIM + DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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FULL CONTENTS

[Claim(s)]

[Claim 1] One or more reaction containers which have up opening, and the sample feed means and the reagent feed means of supplying a sample and a reagent from the opening, In chemical-analysis equipment equipped with a Measurement Division means to measure the physical properties of said sample which the reaction during a reaction ended Chemical-analysis equipment characterized by having a means to detect automatically the hydrophilic nature or such combination to the viscosity, the density, surface tension, or reaction container of a sample and a reagent, and a means to measure the grade of churning automatically at the time during churning operation of termination.

[Claim 2] Chemical-analysis equipment characterized by having an acoustic-wave development means to be prepared in the reaction container exterior and to irradiate an acoustic wave to this reaction container in the chemical-analysis equipment of Claim 1.

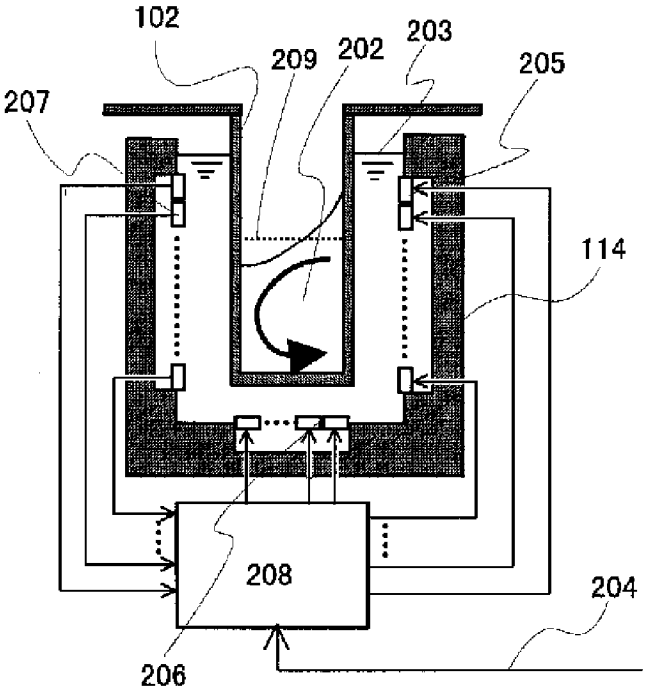
[Claim 3] Chemical-analysis equipment characterized by using change of the load of the source of churning actuation for Measurement Division of said sensing or said mixing extent, or such combination in chemical-analysis equipment according to claim 1.

[Claim 4] Chemical-analysis equipment which is equipped with a means to detect the generated acoustic wave in chemical-analysis equipment according to claim 2, and is characterized by using change of the propagation of the acoustic wave between said acoustic-wave development means and a detection means for Measurement Division of said sensing or said mixing extent, or such combination.

[Claim 5] Chemical-analysis equipment characterized by using load change of an acoustic-wave development means for Measurement Division of said sensing or said mixing extent, or such combination in chemical-analysis

Drawing selection | Representative draw

図2



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equipment according to claim 2.

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to chemical-analysis equipment, and relates to the reagent in a reaction container, and churning for mixing of a sample especially.
[0002]
[Description of the Prior Art] With conventional chemical-analysis equipment, an agitator style dips a spatula and a screw in an object to be agitated, to the inside for [agitating], generates floating and is mixed by those revolutions.
[0003] Moreover, the agitator style which uses a supersonic wave instead of a spatula or a screw is indicated by JP,H8-146007,A. That is, a supersonic wave is irradiated at an object to be agitated, and by it, using the sound style of the agitating object itself to produce, a sample and a reagent are agitated by non-contact and it mixes.
[0004]
[Problem to be solved by the invention] When fully mixing the object in a reaction container to be agitated, it is necessary to generate floating sufficient in a reaction container. Therefore, you have to give the optimal churning operation according to kinetic property peculiar to an object to be agitated. By the churning method using an above-mentioned spatula and an above-mentioned screw, the depth which dips it in the configuration of a spatula, a rotating speed, time of revolution, and an object to be agitated is the parameter of churning operation. Moreover, by the churning method using a supersonic wave, the frequency of an acoustic wave, intensity distribution, etc. are the parameters of churning operation.
[0005] In order to optimize churning, before agitating, it is desirable that the characteristics of an object to be agitated are given beforehand.
[0006] The object of this invention carries out sensing of the characteristics of an object to be agitated before churning execution in chemical-analysis equipment, and is in raising the efficiency of churning and mixing by agitating with the churning parameter optimized based on the result. Moreover, by measuring the mixing grade of the object in the termination event during churning to be agitated, the necessity for re-churning is judged or it is in realizing the agitator style which can give the index of the reliability assessment of an analysis result.
[0007]
[Means for solving problem] The above-mentioned object is attained by having a detection means to detect automatically the hydrophilic nature to the viscosity of a sample and a reagent, a density, surface tension, and a reaction container, or such combination, and a means to measure the grade of churning automatically at the time during churning operation of termination.
[0008]
[Mode for carrying out the invention] One work example of this invention is explained using drawing 1 and drawing 2 . Drawing 1 is the **** figure showing the architecture of the chemical-analysis equipment of this example. Drawing 2 is drawing of longitudinal section showing the architecture of non-contact churning equipment for carrying out sensing (detection) of the characteristics of a liquid automatically to an object being agitated, and performing churning mixing on the optimal conditions for the object being agitated in the chemical-analysis equipment shown in drawing

1 .

[0009] As shown in drawing 1 , this chemical-analysis equipment is equipped with the reaction disc 101 which mainly stores the reaction container 102, and the thermostat 114 for maintaining the homoiothermal condition of the reaction container stored in the reaction disc 101. The reaction disc 101 has the composition that it rotates with the drive mechanism which is not illustrated and a reaction container can rotate the inside of a thermostat 114. Moreover, it has the turntable 103 for the samples which store a sample cup 104, the turntable 105 for reagents which stores the reagent bottle 106, the sampling distributive-pouring mechanism 107 which pours a sample and a reagent distributively in a reaction container, respectively, and the reagent distributive-pouring mechanism 108. Furthermore, it has the photometry mechanism 110 which measures the reaction process of the sample poured distributively, the agitator style 109 which agitates a reagent within a reaction container, and the quality of a mixture in a reaction container, and the absorbance after a reaction, and the washer style 111 which washes a reaction container after inspection (photometry) is completed. This inspection result is outputted to a monitor 113.

[0010] Next, the architecture of the agitator style 109 is explained using drawing 2 .

[0011] The reaction container 201 stored in the reaction disc 101 has repeated the revolution and the rundown action automatically by the program of the main controller 112, being dipped in the homoiothermal water 203 in a thermostat 114. When it stops in the location equipped with the agitator style 109 in a thermostat 114, the agitator style 109 starts an action by the commander 204 from a main controller 112. The agitator style 109 has the composition of having installed the side array sound source 205 arranged in the shape of an array, and the lower part array sound source 206 in the thermostat 114 so that an acoustic wave can be irradiated by arbitrary intensity distribution from the side face and base of the reaction container 102. Moreover, it has composition which the carrier phoneme child 207 for measuring the intensity distribution of the acoustic wave which it glared from the side and has penetrated the reaction container 102 installed in the opposite side of a side sound source in the shape of an array like the sound-source side.

[0012] Each of these compositions operate according to the program automatically created from a main controller 112 based on the analysis article beforehand set up by the console 113, before starting inspection.

[0013] In the above architecture, this chemical-analysis equipment operates as follows. First, the sampling mechanism 107 pours a sample distributively in the reaction container 102 from a sample cup 104. Next, the reaction disc 101 which stored the reaction container 102 rotates to a reagent distributive-pouring location. Then, the reagent distributive-pouring mechanism 108 pours a reagent distributively in the specified quantity reaction container 102 from the reagent bottle 106. Furthermore, the reaction disc 101 rotates to the location in which the agitator style 109 is installed. Then, churning mixing of the sample in a reaction container and a reagent is performed.

[0014] When churning is completed, the reaction disc 101 rotates to a side orientation. Then, measurement is started by the photometry mechanism 110. When measurement is completed, the reaction disc 101 rotates to a washing location. Then, the sample in a reaction container and the mixture of a reagent are attracted by the washer style 111, and washing treatment of the reaction container is carried out. Such a series of processes are advanced in batch processing in detail to two or more samples.

[0015] It connects with the controller 208 and the sound-source system and

**** system in the agitator style 109 perform an action as shown below. In addition, the amplifier which amplifies the driver for driving a piezoelectric element and the output from the carrier phoneme child 207 is built in the controller 208 of this agitator style 109 shown in drawing 2 .

[0016] By the commander 204 from the main controller 112 of the body of chemical-analysis equipment, the hydrophilic nature to the oil-level height 209 of the object in the reaction container 102 to be agitated, surface tension, and a wall surface etc. is first detected prior to churning execution. These detection methods are explained using drawing 3 and drawing 8 . The fundamental flowchart about the action of this controller 208 is shown in drawing 3 . Drawing 8 is drawing showing the development situation of an acoustic wave.

[0017] As shown in drawing 8 (a), the side array sound source 205, the sound source of the lot which counters out of the carrier phoneme child 207, respectively, and a carrier phoneme child are operated. And the penetrations 301 and 302 of the local acoustic wave of the reaction container in the location are measured. Under the present circumstances, the acoustic wave to send penetrates a reaction container, and that acoustic wave does not work at all to the oil level in a reaction container further, or the weak thing been the grade which can disregard that effect is important. Such an action is performed among drawing about the group of each sound source from the n-th or No. n to [from No. 1] the 1st, and a carrier phoneme child, and it measures about the transmission quantity of the acoustic wave in each location (step 310 of drawing 3). Under the present circumstances, in the case where there is nothing with the case where a liquid is in a reaction container, the acoustic impedance which an acoustic wave spreads differs remarkably. Therefore, the difference in the acoustic wave to penetrate arises. Therefore, it will ask for the difference of the transmission quantity of the acoustic wave in each location (step 311), and the location where the value is the biggest will call it the location (step 312) where an oil level 303 exists. As detection of an oil level has many several n groups of a sound source and a carrier phoneme child, i.e., fractionation of an array, it cannot be overemphasized that high-precision oil-level detection can be performed.

[0018] Next, if the strong acoustic wave 305 by which hardness inclined toward the sound-source side is irradiated as shown in drawing 8 (b) from a downward sound source, and an oil level 306 is made the reaction container side face by the side of a sound source, in connection with this, an oil level 307 will fall on the side face by the side of opposite. The connection between modification of such an oil level and the hardness of the acoustic wave irradiated from Shimokata is governed by the characteristics (the hydrophilic nature to surface tension and a reaction container wall, the density of an object to be agitated, etc.) of the object to be agitated. For this reason, if the hardness of the acoustic wave irradiated from a downward sound source and the bias of an oil level are measured, the above-mentioned characteristics of an object to be agitated can be identified (step 313). As an example, by drawing 8 (b), it crosses throughout the height of an oil level, an acoustic wave 308 is irradiated, and how to identify the condition of an oil level is shown from the field 309 penetrated to the opposite side. It becomes possible to presume the characteristics of an object to be agitated with more sufficient precision by changing continuously the intensity distribution 306 of the acoustic wave currently irradiated from the downward sound source using such a method, and measuring continuously the conditions 306 and 307 of the oil level corresponding to it.

[0019] In the phase which the treatment which carries out sensing ended, the characteristics of such an object to be agitated [a controller 208] Based on many weighted solidity identified the detected oil-level height, for the

object to be agitated, the optimal churning parameter (intensity distribution and its time changes hysteresis of an exposure acoustic wave of the side and a lower part) is set up (step 314), and churning is performed (step 315).

[0020] If churning and mixing operation are fully performed, the density of an object to be agitated, viscosity, and the sound wave velocity accompanying them will become uniformly and equal in every point among an object to be agitated. Therefore, the variation is small when it after the uniform termination of churning is compared with BARATSU of the penetration acoustic wave between each sound-source-carrier phoneme child at the time of detecting oil-level height before churning of an uneven condition. Moreover, when carrying out sensing of the characteristics, the exposure hardness of a lower part sound source and the connection of the bias of an oil level which were measured continuously differ from each other before and after churning. Then, it becomes possible by carrying out, also after agitating sensing before churning, and the same sensing, and comparing both to evaluate the achievement condition of churning and mixing as an effect of this example.

[0021] As an effect of this example, it becomes possible to share the hardware which carries out sensing of the sound source which agitates by such architecture and a controller, and the object to be agitated, and it becomes possible in the location of one place of chemical-analysis equipment to perform churning and its assessment. Moreover, since it is the agitator style which functions autonomously only by the commander 204 of the trigger from a main controller 112 without giving the information about volume and characteristics of an object to be agitated, it is very effective in the chemical-analysis equipment which carries out analysis treatment of two or more unspecified objects to be agitated in batch.

[0022] At agitator guard of the previous work example, using the penetration of an acoustic wave, it is the method of carrying out sensing of the oil-level characteristics of an object to be agitated, and the carrier phoneme child 207 needed to be installed. The work example of the sensing method of other principles which does not need this carrier phoneme child 207 is explained using drawing 4 and drawing 5 . Drawing 4 is the block diagram and it differs in that there is no carrier phoneme child 207 of the side compared with drawing 2 . Drawing 5 shows the operation situation of each sound source like drawing 8 . The principle of sensing in this case and the action of a controller 208 are as follows.

[0023] The volts alternating current 502 is made to impress to the piezoelectric element 501 like drawing 5 (b), and if the conditions of a front medium that the acoustic wave is irradiated differ when making an acoustic wave 503 glare as shown in drawing, acoustical load will also change. For this reason, the connection, electric impedance 504, i.e., applied voltage, of the piezoelectric element 501, of the flowing ratio of electric current 505 changes. Therefore, when driving a sound source, each sound source of the array sound source 205 is irradiated one by one like the work example of drawing 2 , drawing 3 , and drawing 8 , acting as a monitor of the voltage 504 and the connection of electric current 505 which are impressed. As a result, the difference in the electric impedance of a sound source arises between [509 and 510] the sound sources located in the height of an oil-level top and the bottom. By using this difference, the oil-level height 508 of the object which exists in the reaction container 506 to be agitated is detectable.

[0024] Moreover, as shown in drawing 5 (c), the height is detectable about the oil level 512 of the side currently raised by this example in the bias of the oil level at the time of irradiating an acoustic wave 511 from a lower part as well as a previous work example. Therefore, many characteristics of

an object to be agitated are identified like a previous work example from the hardness 511 of the acoustic wave irradiated from Shimokata, and the connection of the height 512 of the oil level raised.

[0025] Moreover, it cannot be overemphasized by comparing the result of sensing before churning with the condition at the termination event of churning similarly that it is possible to evaluate churning and mixing.

[0026] Moreover, the source system of real intention and a **** system are applicable not only to the height of the oil level in a reaction container but the height of the oil level of the homoiothermal water besides a reaction container.

[0027] Other work examples which simplify a **** system to the work example of drawing 2 are explained using drawing 7 . Drawing 7 shows the sectional view of the reaction container of a churning location.

[0028] Points which are different in this example and the work example of drawing 2 are the point which made the **** system the sound-source system 701 which is not array-ized, and a point controlled so that a controller 208 operates as follows. Moreover, the sound source 205 in this example becomes a carrier phoneme child also for the sound-source element equipped with the piezoelectricity effect and the inverse piezolectric effect like a piezoelectric material.

[0029] With said architecture, an acoustic wave weaker than the sound-source system 701 is first irradiated uniformly in the case of sensing before churning. And in the reaction container 201, the acoustic wave which has penetrated the portion with which the liquid is filled is detected by the array sound-source system 205, and the height of an oil level is identified. Then, identification of the characteristics of an object to be agitated is the same as that of the work example of drawing 3 . And after NSHINGU is completed, it agitates on the optimal acoustic-wave exposure conditions using the sound source 205 from the side, and the sound source 206 from a lower part like the work example of drawing 3 .

[0030] In said two work examples, it can carry out also about the spatula revolution type agitator style used now. The work example is explained using drawing 6 . A knife revolution type agitator style is shown in drawing 6 .

[0031] This example is the almost same architecture as a conventional spatula revolution type agitator style. It consists of a spatula 601, a motor 602 connected to the bottom in order to rotate it, and a move mechanism in which these rise and fall that are not illustrated are performed. However, as shown in drawing, such information is incorporated into the core of the controller 603 which controls a motor with the performance which acts as a monitor of the voltage 604 currently impressed to the motor 602, and the electric current 605, and the driving driver 606 which controls the voltage impressed to a motor is built in it.

[0032] In this example, if the load torque of a motor 602 changes, the connection between the voltage currently impressed and the electric current which flows in then, i.e., the electric impedance of a motor, will change. If it is made to descend using the characteristics of such a motor, rotating a spatula from on an oil level, the load of a motor will be changed from the moment the spatula touched the oil level. For this reason, the electric impedance of a motor changes. The height of an oil level is detectable from this changing location. Furthermore, the depth flooded with the liquid of the spatula when it is made to descend, rotating a spatula, And from the connection of electric impedance, the characteristics (viscosity, a density, etc.) of an object to be agitated are identified, a controller 603 sets up automatically the optimal churning parameters (the number of rotations of a spatula, time of revolution, the rise-and-fall antenna radiation pattern of a

spatula, etc.), and churning mixing is performed.
[0033] Moreover, it becomes possible to evaluate the achievement condition of this churning and mixing from the difference of the electric impedance difference in the motor in the location which has a spatula before and after churning like said two work examples.
[0034]
[Effect of the Invention] as explained above, according to this invention, it is in raising the efficiency of churning and mixing by carrying out sensing of the characteristics of an object to be agitated before churning execution, and agitating with the churning parameter optimized based on the result -- it is possible.
[0035] Moreover, it is possible by measuring the mixing grade of the object in the termination event during churning to be agitated to realize the agitator style which the necessity for re-churning is judged or can give the index of the reliability assessment of an analysis result.

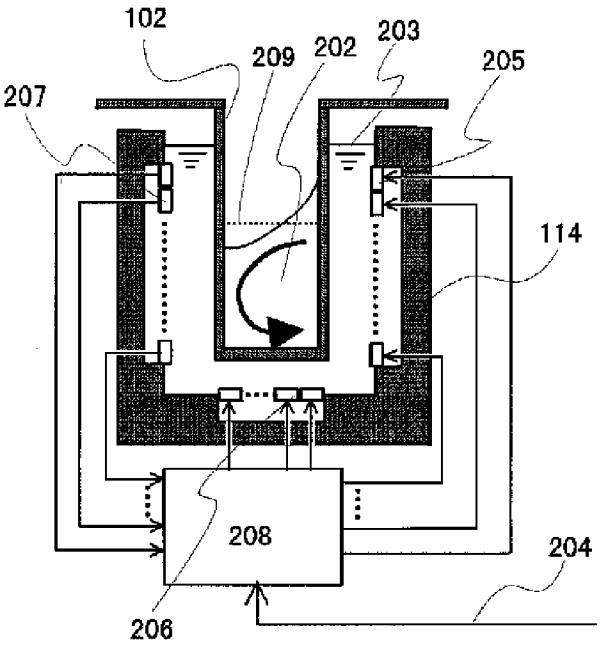
[Brief Description of the Drawings]
[Drawing 1] It is the **** figure showing the architecture of the whole chemical-analysis equipment of this invention.
[Drawing 2] They are drawings of longitudinal section, such as a reaction container in the churning location of this invention.
[Drawing 3] It is drawing showing the flowchart of an action of this invention.
[Drawing 4] They are drawings of longitudinal section, such as a reaction container of other work examples in the churning location of this invention.
[Drawing 5] It is the explanatory view showing the principle of operation of drawing 4 .
[Drawing 6] They are drawings of longitudinal section, such as a reaction container of other work examples in the churning location of this invention.
[Drawing 7] They are drawings of longitudinal section, such as a reaction container of other work examples in the churning location of this invention.
[Drawing 8] It is the explanatory view showing the principle of operation of drawing 3 .
[Explanations of letters or numerals]
101 -- A reaction disc, 102 -- A reaction container, 103 -- The turntable for samples, 104 -- A sample cup, 105 -- A reagent bottle, 106 -- Turntable, 107 -- A sampling mechanism, 108 -- A reagent distributive-pouring mechanism, 109 -- Agitator style, 110 -- A photometry mechanism, 111 -- A washer style, 112 -- Main controller, 113 [-- The commander from a main controller,] -- A console, 202 -- An object to be agitated, 203 -- Homoiothermal water, 204 205 -- A side array sound source, 206 -- A lower part array sound source, 207 -- Carrier phoneme child, 208 [-- An impression power source, 503 / -- An acoustic wave, 504 / -- A voltmeter, 505 / -- An amperometer, 601 / -- A spatula, 602 / -- A motor, 606 / -- Motorised driver.] -- A controller, 209 -- An oil level, 501 -- A piezoelectric element (sound source), 502

[Drawing 1]

ID=000003

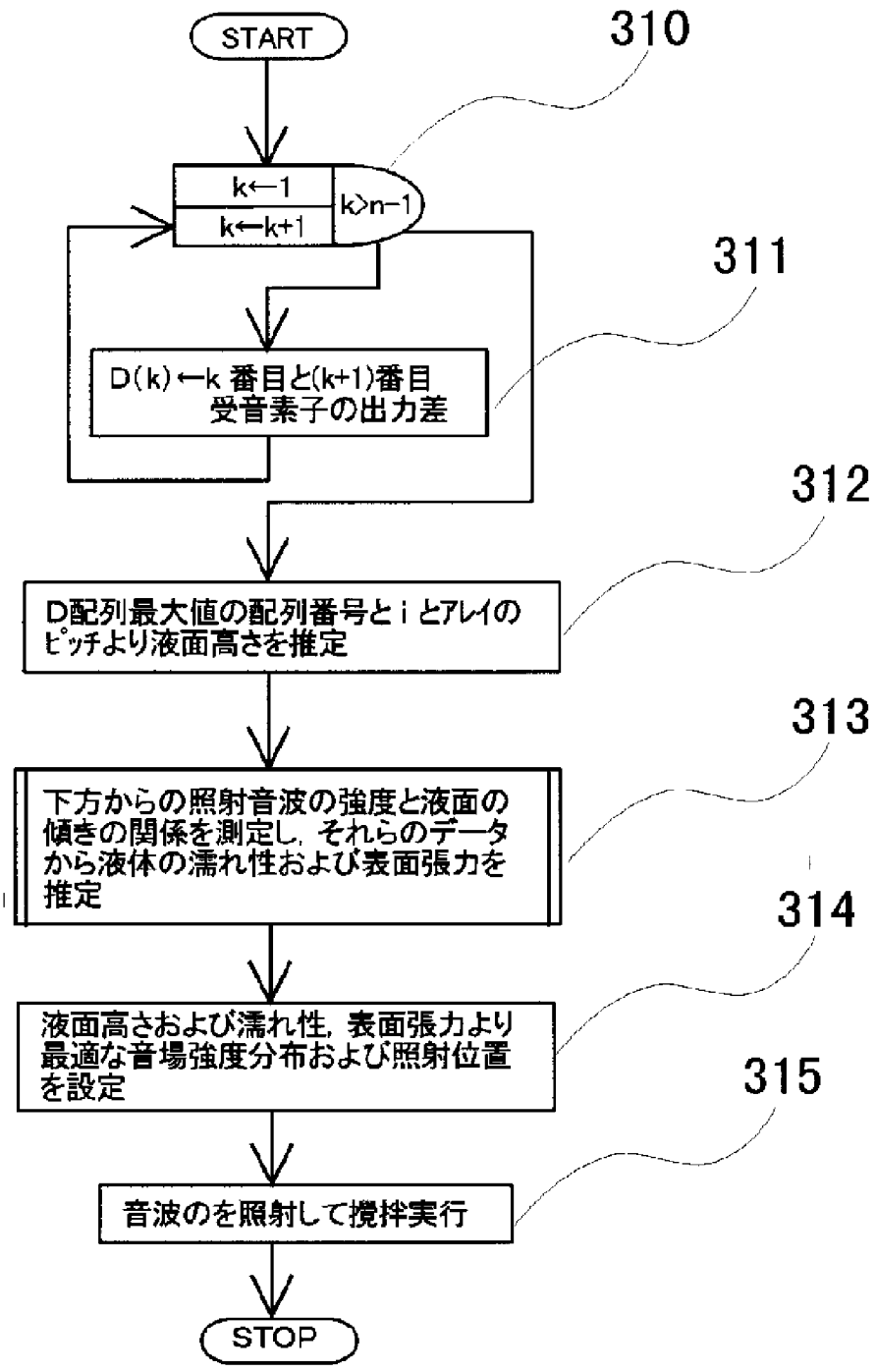
[Drawing 2]

図2



[Drawing 3]

図3

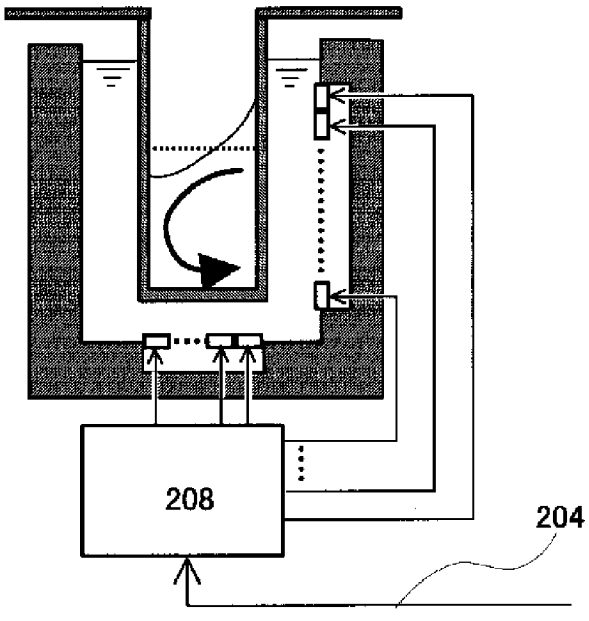

START
310
k←1
k←k+1
k>n−1
311
D(k)←k 番目と(k+1)番目
受音素子の出力差
312
D配列最大値の配列番号とiとアレイの
ピッチより液面高さを推定
313
下方からの照射音波の強度と液面の
傾きの関係を測定し，それらのデータ
から液体の濡れ性および表面張力を
推定
314
液面高さおよび濡れ性，表面張力より
最適な音場強度分布および照射位置
を設定
315
音波のを照射して撹拌実行
STOP

[Drawing 8]

ID=000010

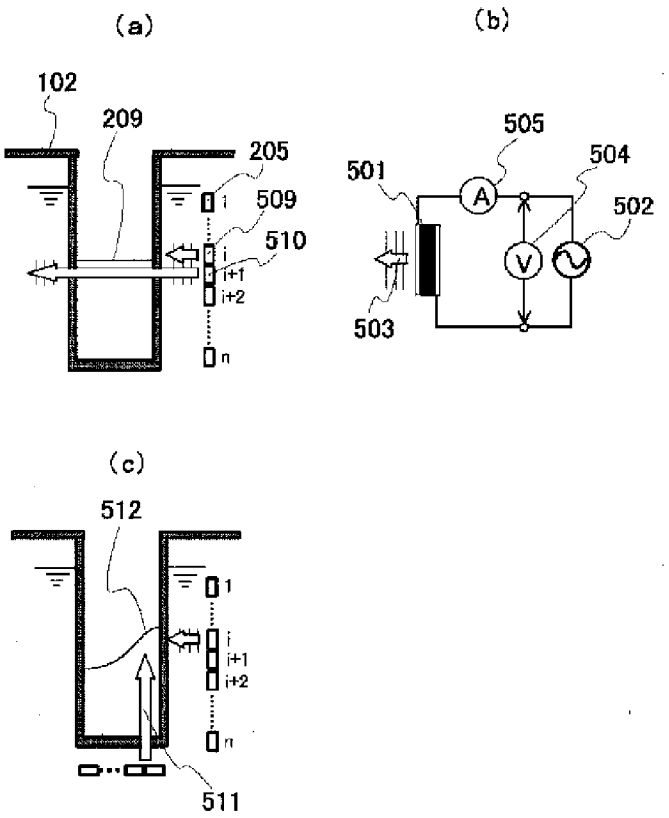
[Drawing 4]

図4



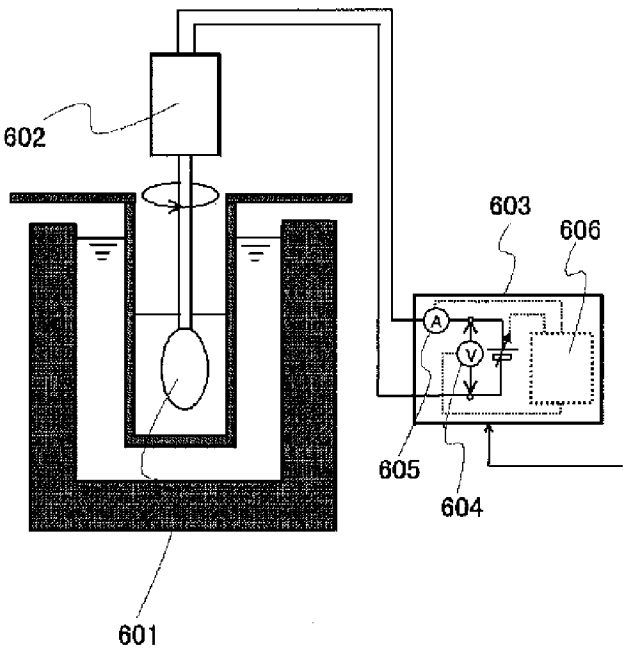
[Drawing 5]

図5



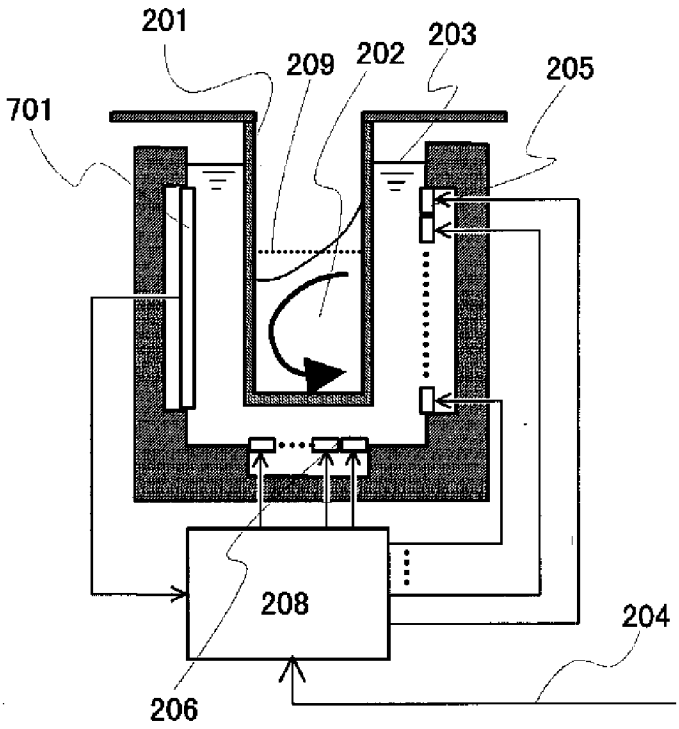
[Drawing 6]

図6



[Drawing 7]

図7



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